

# Atos

## Package selection



AVALON  
SOLUTIONS



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## Document history

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### Approvals

This document requires the following approvals:

#### Project Board

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### Distribution

This document has been distributed to Project Board and Contributors and additionally to:

Name	Title	Version	Date
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# 1. Introduction

For the solution selection for Atos, the simulation software needs to fulfill a set number of requirements. For this, we have determined where the simulation software lies within the process of creating demos. The simulation software must above all else be able to connect to SAP through an OPC (Open Platform Communications) client. Below is a visualization of this connection and what the results need to be from the simulation software.

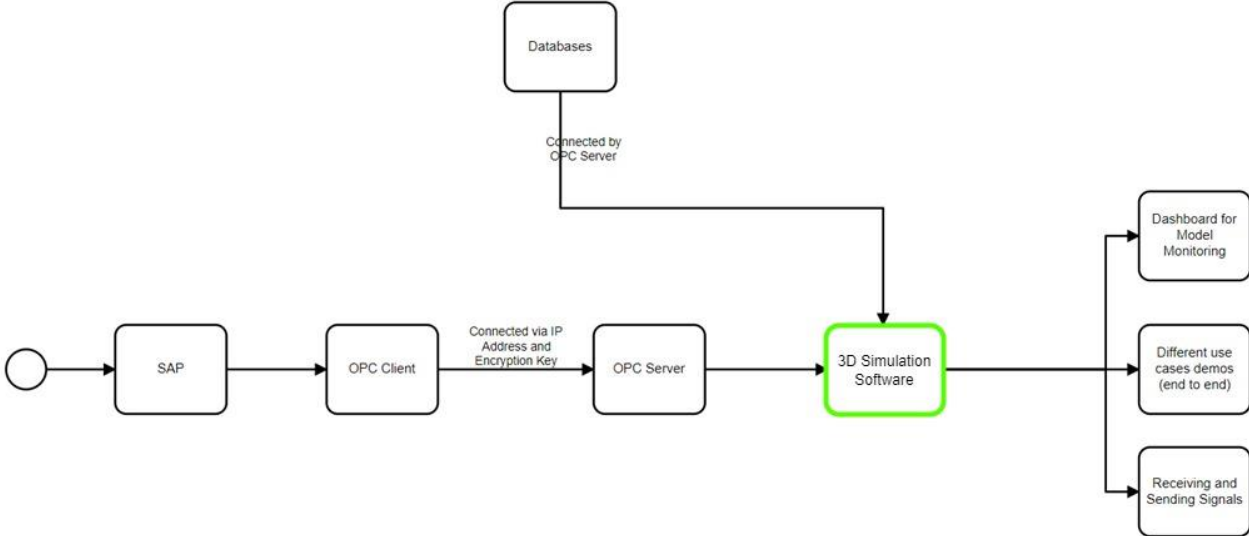


Figure 1 - Baseline Architecture

## 2. Software selection

### 2.1 KPI's

This is a list of KPI's as selection criteria that have been determined over time through talking with the client and the comparisons of different products.

ID	KPIs (Key Performance Indicators)
1	aesthetically appealing
2	Displays discreet and continuous manufacturing processes
3	The package must be OPC compatible.
4	The package must be compatible with SAP
5	The package must visualize manufacturing process using 3D models
6	The 3D models are/can be animated
7	The 3D models can be added by drag & drop
8	The package sends and receives signals from/to the ERP through the OPC connection
9	The number moving items displayed should be at least 20
10	Re-usable manufacturing modules
11	Measurement and decision-making statistic tools (ExpertFit and Stat:Fit )
12	Dashboard for visualizing model performance
13	Accessible via browser and stores data on cloud
14	Compatible databases (MySQL, Access, ODBC, SAP Hana etc)
15	Training and Pricing

Table 1 - KPIs

## 2.2 3D factory simulation software

Following is a list of every potential (3D) simulation software we found over the course of this project.

### Anylogic

- Discrete event
- System dynamics modeling
- Primary markets:
  - Supply chains
  - Warehouse operations
  - Manufacturing and material handling
- AnyLogic cloud – web service that allows AnyLogic users run and access models from a web browser on any device, compare results, compare custom dashboards, and perform various experiments
- Operates on all systems – Windows, Mac, Linux
- Any database
- Reports, Model execution logs, Charts, Output to the built-in database or any external data storage (databases, spreadsheets, text files)
- Material Handling library
- The only simulation tool that supports combining Discrete Event, Agent-Based, and System Dynamics simulations in one model.
- Has OPC connection <https://forum.prosysopc.com/forum/opc-ua-client/communication-anylogic-opc-ua-server/>
- <https://answers.sap.com/questions/11282378/discrete-simulation-environment-in-sap.html>

### ARENA

- Used for simulating and analyzing existing and proposed systems as well as operational analysis.
- Manufacturing, Supply chains, Logistics
- Only for windows
- Visual Studio for the purpose of automation as well as VB
- Has OPC connection <https://products.centraline.com/no/pdf/en0z1024-ge51r1219.pdf>
- <https://prostep.us/2019/07/10/openpdm-connect-for-arena-plm-to-sap-integration/>
- Connection to SAP <https://www.arenasolutions.com/wp-content/uploads/prostep-integration-datasheet.pdf>

## **ENTERPRISE DYNAMICS**

- Manufacturing, logistics, and material handling simulation
- Warehouses, Distribution centers
- Pedestrian Dynamics — a crowd simulation software application, designed for the creation and execution of large pedestrian simulation models in complex infrastructures.
- Windows
- Experiment Wizard – an internal feature.
- By providing support for various third-party optimizers.
- By providing a free Viewer License of the software.
- There in OPC connection.

## **EXTENDSIM PRO**

- Professional level tool for modeling and analyzing complex discrete rate, continuous, agent-based, and hybrid systems.
- Consumer products
- ExtendSim DE — entry-level general-purpose, discrete event and continuous simulation tool.
- Windows, Mac
- Excel, Oracle, Access, SQL Server, MySQL
- Any Windows application that can be configured as an Automation controller, such as Excel or Access, can control and communicate with ExtendSim as a COM Automation Server.
- Output to charts & reports, Integrated Scenario Manager with dialog or database factors and responses, sensitivity analysis, confidence intervals, Gantt charts, and quantile and interval statistical analysis., Export to external analysis applications is also available.
- \$25 download for ExtendSim Adopters; \$50 for other students. Research grants are available to use the full version of ExtendSim in research projects for advanced degrees.
- OPC connection

### **Simio Enterprise Edition**

- Monitor, simulate and evaluate production strategies. Reduced downtime
- Improved product quality using insights from analysis of manufacturing facility.
- Ideal product for professional modelers and researchers.
- Powerful object-oriented modeling and integrated 3D animation for rapid model
- Supports databases (Azure, .NET programs, excel access, SQL)
- ExpertFit and Stat:Fit integrated.
- SMORE Plots for risk analysis, sensitivity analysis, custom dashboards, comprehensive data in pivot tables, export summary or details to external packages
- Required Team Edition or above to package model.
- Reusable modules. Manual processes with multiple replications. For discreet and continuous
- Supports 3D, animation, export, and CAD (Computer-aided Design).

### **Plant Simulation**

- Discrete event simulation
- All level of manufacturing processes
- Statistical analysis
- 3d visualization
- SAP and OPC compatible
- Automatic bottleneck detection
- Cost allocation
- Animation and animation export
- Real time viewing
- Training course and support available
- Free student version available



## **Flexsim**

- An inexpensive, risk-free way to test anything from simple revisions to complete redesigns, always with the purpose of meeting production goals at the lowest possible cost.
- Simulation also provides a way to test and implement principles of Lean manufacturing and Six Sigma.
- Comparable and efficient method for forecasting, adjusting parameters and get results faster.
- Well documented modules
- Compatible with Windows OS, Excel and other database software, C++ applications
- Reusable code
- Integrated with ExpertFit (i.e., ExpertFit was designed for people who are building discrete event simulation models; ii. Enough features to make a statistician blush—40 distributions, 30 high-quality graphical plots, 4 technically correct goodness-of-fit tests, and much more.)
- Experimentation can be performed with Batch Runs
- CAD drawings import, 3D animation, Real time viewing, Animation can be exported
- Our PLC emulation is fully integrated with Process Flow, including the PLC connections.
- Free Version of FlexSim runs with any simulation model built.
- Student Version Free
- Support for virtual reality
- Training Courses and on-site training available.
- Answers and guidance involved in each process flow.

## **SaS Simulation Studio**

- Realistic behavior of complex-real world systems.
- Drag and drop, object-oriented for building, debugging, verifying, and enhancing your models step by step.
- Only for discrete event simulation.
- Easy to examine simulated data for analyzing factors.
- Integrated with SAP and JMP analytics.
- Support for large models
- Supports animation and real-time viewing.
- Cannot export animation and no 3D animation.
- No reusable modules. Available to batch run
- Cannot support mixed discrete/ continuous modelling
- Optimization is possible via data transfer to SAS.

## ProModel

- Have a process simulator (For making flowcharts and process diagram simulator)
- Includes a material handling edition for process simulator
- Windows OS, Compatible Databases (Excel, Access, Stat:Fit, MiniTab)
- For measuring input, includes 16 statistical distributions and is integrated with Stat:Fit
- Along with graphical model construction, for analysis of output includes an output viewer, minitab and excel.
- Reusable code
- For optimization includes a SimRunner.
- Does not support model packaging
- Access to programmed modules, includes a Scenario manager for batch run. Discrete and continuous manufacturing flows
- Supports animation and real-time viewing and 3D animation. Cannot export animation

## Simcad

- 2D, 3D and VR (Virtual Reality) settings
- Manufacturing simulation, logistics simulation, automation simulation, healthcare simulation, warehouse simulation and Food & beverage simulation
- Singular model building technology for fast model turn around
- Connection to external databases, PLC's, and SAP.
- Entity relationship intelligence

## Witness

- Discrete and Continuous event modeling
- 2D and 3D Modelling Environment
- Open connectivity to common data sources including files (Microsoft Excel, CSV, CAD, etc.), databases and cloud services.
- Develop logic in compartmentalized modular blocks directly within building elements.
- Supports external code libraries (C++, C# & VB.net.)
- Inbuilt charts and reports
- Easily export simulation data to AI (Artificial Intelligence) tools
- Easily switch between 2D and 3D
- Cloud Access
- Web Portal Access
- REST API (give apps of the client)

## Visual components

- 3D drag and drop
- Process modeling
- 2500 pre-defined models
- CAD file import
- Create, modify, and visualize custom simulation data in the statistics dashboard.
- PLC Connectivity with OPC-UA
- Define, model, and program robot behavior
- Export 3D simulations as high-quality images and videos
- Share and experience the simulations in virtual reality or smartphones.
- These are all functionalities from the essential version, see <https://www.visualcomponents.com/products/> for much more functionalities for the pro and premium version.

### **Sim3D**

- connect to a wide range of PLCs,
- Can be connected to other manufacturers' products via a wide range of industrial standard protocols.
- facilitates robust connections to WMS, WCS, and ERP systems for High Level Emulation.
- 3D drag and drop
- VR (Virtual Reality)
- Import CAD and create company-specific catalog elements

## 2.3 Software comparison

In this section, the 4 different software packages that came best out of the [initial](#) complete software comparison matrix is given. These software's are compared on KPI's, which are listed in section 2.1 of this document. They are [requirements](#) document. The choice to go on with these 4 different software packages was agreed upon with the client.

### 2.3.1 Top 4 comparison

#### KPIs



<b>Aesthetically appealing</b>	6	5	6	10
<b>Displays discreet and continuous manufacturing processes</b>	10	10	10	10
<b>The package must be OPC compatible.</b>	10	10	10	10
<b>The package must be compatible with SAP</b>	10	10	10	10
<b>The package must visualize manufacturing process using 3D models</b>	10	10	10	10
<b>The 3D models are/can be animated</b>	10	5	10	10
<b>The 3D models can be added by drag &amp; drop</b>	10	10	10	10
<b>The package sends and receives signals from/to the ERP through the OPC connection</b>	10	10	10	10
<b>The number moving items displayed should be at least 20</b>	5	10	5	5
<b>Re-usable manufacturing modules</b>	10	10	10	10
<b>Measurement and decision-making statistic tools (ExpertFit and Stat:Fit )</b>	10	10	10	10
<b>Dashboard for visualizing model performance</b>	10	10	10	10
<b>Accessible via browser and stores data on cloud</b>	5	1	1	5
<b>Compatible databases (MySQL, Access, ODBC, SAP Hana etc.)</b>	10	10	10	5
<b>Training and Pricing*</b>	5	5	5	5
<b>Total</b>	491	486	472	430

1 - Does not meet criteria  
 5 - Somewhat meets criteria  
 10 - Fully meets criteria

Table 2 - Software comparison matrix

\*Training and pricing are dependent of the package choice

### 2.3.2 Benchmark

In this section, the 4 selected 3D simulation software's from the previous section are compared. This is done based on a benchmark. In this benchmark, the various software's are compared based on the use cases that have been given by ATOS (Beer brewery and pencil manufacturing (see image below)).

The following tools are compared in the benchmark: Anylogic, Flexsim, Siemens plantsim and Visual Components. The 2 different use cases are created in the 4 different software's. The findings of these benchmarks are documented in the table on the next page. Together with the comparison of KPIs mentioned in section 2.1 in the previous section, and the SWOT analysis in the next section, this will serve as a guideline for the advice for the chosen software tool.

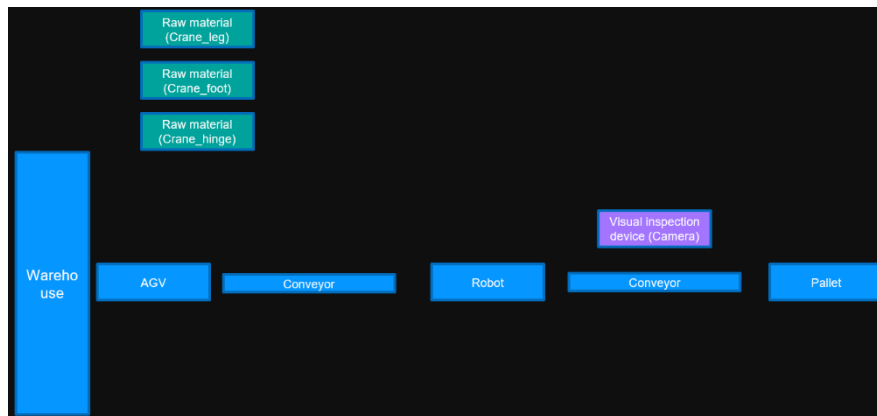


Figure 22 - Use case crane stabilizer manufacturing

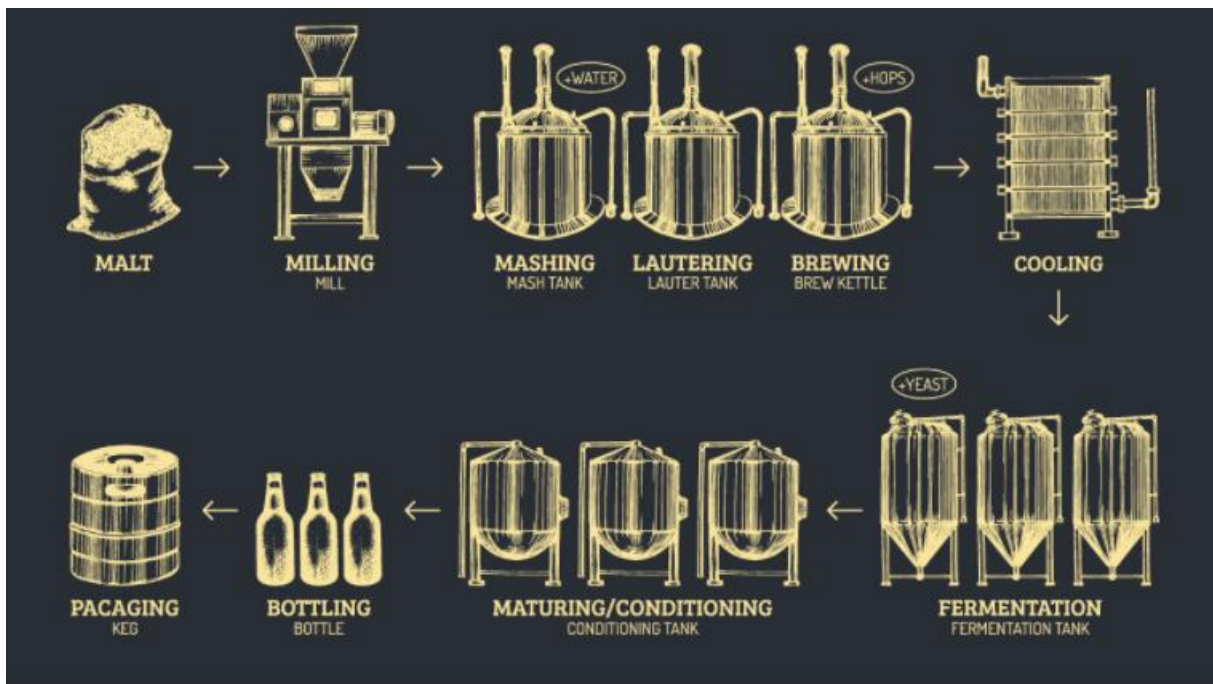


Figure 33 - Use case beer brewery

## AnyLogic

Table 3 - Benchmark Anylogic

	Findings	Documentation on the internet (tutorials, videos, etc.)	Overall user score
<b>Beer brewery</b>	There is not a fluid process related documentation, which makes it impossible for someone without knowledge of the software to produce this kind of simulation.		5/10
<b>Pencil manufacturing</b>	Although the software offers many functionalities, it is very hard to build models on your own without following already the provided demo inside the software. The software is not very well documented.		6/10

## Flexsim

	Findings	Documentation on the internet (tutorials, videos, etc.)	Overall user score
<b>Beer brewery</b>	The drag and drop system make it easy for a beginner to create processes. Functionality to add your own custom 3D objects and add automation. Limited objects caused some constraints.	<a href="https://youtu.be/zyvf0c5rFvo">https://youtu.be/zyvf0c5rFvo</a> Beer Brewery process of Atos	8/10
<b>Pencil manufacturing</b>	Quite easy and straightforward way of setting up the demo. Process used basic assets, but possible to import custom models. Dashboards/simulated data are limited, need to find how to include custom data.	<a href="https://docs.flexsim.com/en/22.0/Tutorials/FlexSimBasics/BasicsOverview/BasicsOverview.html">https://docs.flexsim.com/en/22.0/Tutorials/FlexSimBasics/BasicsOverview/BasicsOverview.html</a>  <a href="https://www.youtube.com/c/FlexSim/videos">https://www.youtube.com/c/FlexSim/videos</a>	7/10

Table 4 - Benchmark Flexsim

## PlantSim

	Findings	Documentation on the internet (tutorials, videos, etc.)	Overall user score
<b>Beer brewery</b>	For the continuous process there are few options, only extremely basic ones. The use of the software also gives some problems, as it is not always easy to connect different components. For the components that are available there are a lot of options to edit, animate and let them perform multiple tasks. This is at first hard to do, and more tutorials would be helpful. The environment also does not look as visually appealing as that some other software's do.	There is not much documentation on the software, there are some tutorials but not that many. The tutorial that can be found are very extensive. There also is a forum but it is not regularly active.	5.5/10
<b>Pencil manufacturing</b>	For the discrete processes there some options to make a process flow visible in a 3d environment. There are few components to use, and it is hard to code them to do specific tasks. It takes a lot of time to make the pencil manufacturing because it is hard to get the knowledge and the result of all the time is very minimum.		5/10

Table 5 - Benchmark PlantSim

### Visual components

	Findings	Documentation on the internet (tutorials, videos, etc.)	Overall user score
<b>Beer brewery</b>	Hard to find information about how this works without training, not a lot of documentation on process industry. There are possibilities but these are not clear for a user that is new to the program, and it will require time to find this out.	There is an academy page on their website. On this page you can find different courses, learning paths, lessons, and webinars. These courses do not always have clear explanations, as some have pdf's where some steps are missing when you are not familiar with the software.	5/10
<b>Pencil manufacturing</b>	Basic movements in the process are quite easy to do. But putting more of these basic movements in one flow is already harder and for this process it has not been able to succeed. Things that are harder are combining of the various products and doing more advanced stuff in the process flow. There are a lot of different possibilities for manufacturing, which makes the tool powerful.		7/10

Table 6 - Benchmark Visual Components

### 2.3.3 SWOT

In this section, a SWOT analysis will be conducted for each of the 4 chosen software packages. The primary objective of the SWOT analysis is to help develop a full awareness of all the factors involved in making the decision between the software packages (Schooley, 2022).

#### Anylogic

<b>Strengths</b> <ul style="list-style-type: none"> <li>- Detailed, offers in depth possibilities of visualization and components programming</li> </ul>	<b>Weaknesses</b> <ul style="list-style-type: none"> <li>- Will lose a lot of time if the required demo cases need to be built</li> </ul>
<b>Opportunities</b> <ul style="list-style-type: none"> <li>- Work with the market lead in terms of manufacturing simulation</li> </ul>	<b>Threats</b> <ul style="list-style-type: none"> <li>- Not enough tutorials to learn how to use it independently</li> </ul>

Table - SWOT Anylogic

#### Flexsim

<b>Strengths</b> <ul style="list-style-type: none"> <li>- Simple, quick assembly</li> <li>- Learning curve is not steep; easy to start, can be time-consuming to master</li> </ul>	<b>Weaknesses</b> <ul style="list-style-type: none"> <li>- Library for models and dashboard templates is limited</li> <li>- Free version has a hard limit of 30 models</li> <li>- The learning process is quite time consuming</li> </ul>
<b>Opportunities</b> <ul style="list-style-type: none"> <li>- <b>Custom models are possible</b></li> <li>- <b>Custom data generation is possible</b></li> </ul>	<b>Threats</b> <ul style="list-style-type: none"> <li>- Expensive</li> </ul>

Table - SWOT Flexsim



## Siemens plantsim

<p><b>Strengths</b></p> <ul style="list-style-type: none"> <li>- Possible to simulate a whole factory</li> <li>- Good looking visualization</li> <li>- SAP connection</li> </ul>	<p><b>Weaknesses</b></p> <ul style="list-style-type: none"> <li>- Hard to gain the knowledge</li> <li>- Hard to quickly adjust a demo for a new project</li> <li>- Have to invest a lot of time for minimum results.</li> </ul>
<p><b>Opportunities</b></p> <ul style="list-style-type: none"> <li>- Strategic partner (Siemens) of Atos</li> <li>- The software developers are from a big company (Siemens). It is good to have a big company to rely on and they probably keep up with the market.</li> </ul>	<p><b>Threats</b></p> <ul style="list-style-type: none"> <li>- Hard to find tutorials on how to use the software in different situations.</li> <li>- Expensive</li> </ul>

Table - SWOT plantsim

## Visual components

<p><b>Strengths</b></p> <ul style="list-style-type: none"> <li>- Visually very appealing.</li> <li>- Extensive software with many possibilities.</li> <li>- Training/tutorial opportunities.</li> <li>- Basic processes are easy to make.</li> <li>- Robots can be custom assembled and programmed for tasks.</li> </ul>	<p><b>Weaknesses</b></p> <ul style="list-style-type: none"> <li>- Extensive software, which takes a lot of time to learn.</li> <li>- Does not have extensive continuous manufacturing options.</li> <li>- Extensive processes are hard to make.</li> </ul>
<p><b>Opportunities</b></p> <ul style="list-style-type: none"> <li>- The software is updated very frequently.</li> </ul>	<p><b>Threats</b></p> <ul style="list-style-type: none"> <li>- Difficulty contacting for information/trail license</li> <li>- The software is less known than other competitors.</li> </ul>

Table 7 - SWOT Visual components

## 2.4 Visual components MoSCoW

To make a choice if visual components is the right 3D factory simulation software it is important to know which version from the software is needed for the requirements ATOS has. Visual components have 3 different license types: essential, professional, and premium. In this MOSCOW, the distinctive features will be compared and there will be chosen a license type that fits ATOS.

The MOSCOW model is used to prioritize what functionalities Atos needs to make the demo cases. When we know this information, it could be helpful to select what package of Visual components Atos needs to buy. The MoSCoW method is a way of setting priorities, this is done based on the following priority classes:

<b>M</b>	<b>Must haves</b> These functionalities must return in the end result.
<b>S</b>	<b>Should haves</b> These functionalities are highly desirable, but not indispensable.
<b>C</b>	<b>Could haves</b> These functionalities are not necessarily necessary.
<b>W</b>	<b>Won't haves</b> These functionalities will not be discussed in this project but may be interesting in the future, in a follow-up project.

Features	Essentials	Professional	Premium	MOSCOW
3D Layout Configuration				M
Process Modelling				M
ECatalog				M
CAD File Import				M
Import 2D Drawings				C
CAD Attribute Reader				C
Point Cloud				C
Statistics				M
PLC Connectivity				C
Simple Robotics				S
Sales Content Creation (videos, animations)				M
VC (Visual Components) Experience				C
Component Modelling				M?
Pre-Built Wizards				?
Basic Solid Geometry				C ?
Geometry Simplification				?
Fanuc Robot Connectivity				W
Siemens S7 – PLC Connectivity				W
WinMOD and SIMIT Connectivity				
Geometrical CAD data for Robot Paths				C
Path Statements				C
Paint Process Visualization				C
VRC Connectivity for UR and Stäubli				
Interactive VR (Virtual Reality)				W
VR/3D Conferencing				W

For more information on the different features: <https://www.visualcomponents.com/products/>

### 3. Conclusion

After conducting the research steps in the previous chapter, an advice can be given about which 3D simulation software may be the best fit for the needs of Atos.

As it currently stands, Flexsim, Anylogic and Plant Simulation were selected as the top three options, of which Flexsim was selected by Atos to continue working with as a minimal viable product.

While it does not fulfill the more detailed requests from Atos (Such as product specific assembly animations using robots and custom data generation), it is currently enough to simulate the cases that they give us.

After analyzing and testing Visual components this will be advice as the recommended software. This because the requirements that ATOS had which Flexsim couldn't meet are met by Visual components. More explanation on this choice can be found in the final advice report.